Attending and Resident Physician Perceptions of an EMR-generated Rounding Report for Adult Inpatient Services

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Background: *With limited work hours, efficient rounding and effective hand-offs have become essential. We created a completely electronic medical record (EMR)-generated rounding report for use during pre-rounding, team rounds, and sign-out/hand-offs. We hypothesized that this would reduce workloads.* Methods: *We used a pre- and post-implementation survey of the residents and faculty members of the Departments of Family and Community Medicine and Internal Medicine.* Results: *After 5 months of use, residents and attending physicians reported a daily time savings of 44 minutes. Seventy-six percent of users also agreed that the rounding report improved patient safety. Rounding report users were more satisfied with the rounding process, spent less time updating other lists or documents, and less time pre-rounding. In addition, there were trends toward spending more time with patients, adherence to work-hour rules, increased accuracy of information during sign-out, improved satisfaction, confidence while cross-covering, and decreased clinically relevant errors.* Conclusions: *Utilization of well-designed, EMR-generated reports for the use of patient transfer, sign-out, and rounding should become more commonplace considering the improved efficiency, satisfaction, and potential for improved patient care.*

The practice of inpatient medicine at teaching hospitals is increasingly complex. The volume of demographic, historical, and laboratory data can overwhelm providers.[1] Summarizing patient-level data is one of the most important challenges in building effective tools for clinical decision support.[2] Patient lists that contain key information about patients are commonly used to summarize and transmit information at teaching hospitals. However, maintaining these documents to ensure accuracy of medications, hand-copying laboratory data, and other duplicative tasks is time-consuming. These lists are often printed or copied for signing out to cross-covering teams, and the quality of patient care may depend upon the accuracy of the information transcribed onto these reports.[3]

Previous research on sign-outs has reported incomplete information transmission.[4] With work-hour limitations, sign-outs are increasingly frequent and variable between teams and individuals across the United States[5] as well as in our institution. Disorganized hand-offs are a recognized source of preventable patient error.[6,7] Despite the potential impact, improving the sign-out process has received little attention in the literature.

In addition to updating patient list documents, residents spend valuable minutes "pre-rounding" every morning to copy vital signs, laboratory data, and other pertinent information. Although this redundant system is the standard on many inpatient medical services, the need to conform to an 80-hour workweek requires increased efficiency in the teaching hospital setting.[3,8] Previous authors have identified benefits to a standard computerized sign-out document, including time savings and perceived improvement in patient care.[9-14] However, some systems were designed separately from the electronic medical record (EMR), eg, UWCores,[15] and may require significant data entry by the clinician. In fact, more than half of the data elements in the UW-

Cores system require manual entry by the clinician.[15] Configuring the EMR to contain and report all relevant clinical data elements could significantly improve upon physician time savings and satisfaction.

Using only data elements stored within and generated from our EMR, we developed a "rounding report" to streamline the transfer of patient information, decrease duplicative work, and improve efficiency and residents' satisfaction with work and patient care. This rounding report replaces the traditional patient list document and mines the EMR for vital signs, laboratory data, medications, and problem lists. We hypothesized that implementing a standard computer-generated document for daily ward rounds would increase resident efficiency and improve the quality and accuracy of the information transferred between care teams at sign-outs. We surveyed resident and attending physicians before and after implementing an EMR-generated rounding report to determine the report's effects on perceived efficiency, quality, and satisfaction. Results of these surveys are presented in this report.

Methods

Rounding Report Design and Training

Before the start of our study, most medical services with residents in the University of Missouri Health System (UMHS) maintained a separate patient list system with Microsoft Word, Excel, or Access software. Using Microsoft Office applications for patient tracking at teaching hospitals is a widely based practice[15] that has also been the experience of the authors. The EMR at UMHS (Millennium PowerChart, Cerner Corporation, Kansas City, MO) includes a template for a rounding report. The default template, however, was missing many elements found in the separate patient list systems, and of the elements displayed, many were in an undesirable format. It was determined that a customized report would best meet the needs of our physicians.

The first author (KMK), a practicing clinician with experience caring for hospitalized patients and training in medical informatics, developed the first draft of an Adult Inpatient Rounding Report that incorporated many of the elements included in the separate patient list systems and would still fit on one page. This initial design was reviewed by two focus groups led by the first author and comprised of four to six residents and inpatient attending physicians within the Departments of Family and Community Medicine and Internal Medicine. A programmer familiar with the required programming language, report writing, and rich text formatting built a custom report in our EMR, accommodating most of the focus groups' input into the final report (Figure 1). The final report went through a testing and validation process for accuracy before it was available for use on any inpatient service. KMK taught chief residents and senior residents how to access and

print these reports. Senior residents then taught the remaining residents and attendings how to access and use the reports through structured didactic time on the inpatient service.

Evaluation Design

The evaluation was approved by the Health Sciences Institutional Review Board at the University of Missouri. KMK designed pre- and post-implementation surveys with editorial feedback from all coauthors. We sent the survey to two attending physicians, two resident physicians, and two nonclinicians. Based on their feedback, we revised the survey. We then administered it with an Internet-based survey tool (www.SurveyMonkey.com). There are five general medical inpatient services (two services run by the Department of Family and Community Medicine and three services run by the Department of Internal Medicine) at the University Hospital within UMHS. Residents who rotated on these services and any faculty members who attended on these services were asked to complete surveys. No reimbursement was offered for survey completion.

Data Collection

For the pre-implementation survey, we sent up to three e-mail invitations to 93 residents and faculty members in May 2008. These physicians were scheduled to work on their respective inpatient services over the ensuing 5 months. We excluded graduating clinicians; few had an inpatient rotation scheduled during the last two months of their training. The e-mail had a hyperlink to the online pre-implementation survey. In May 2008, the Adult Inpatient Rounding Report was enabled for all users of our EMR. In October and November of 2008, we sent up to three e-mail invitations to 108 residents and faculty members to participate in a post-implementation survey. For the post-implementation survey, we added 15 new first-year residents to get their comments and feedback about the system, even though they did not provide pre-implementation surveys for comparison.

Statistical Analysis

We included only paired data for residents and attending physicians who responded to both surveys for relevant questions. For example, attendings do not typically take part in updating a patient list, signing out, or pre-rounding, so their data for those questions were excluded. To determine if participants who responded to only one survey differed from those who responded to both surveys, we compared responses for the questions relating to the amount of time spent on various tasks using the Wilcoxon rank sum test.

We used five-category responses for several survey questions, with responses ranging from "strongly agree" to "strongly disagree" or "very satisfied" to

"very dissatisfied," including a "neutral" response in each question. Categorical responses were grouped to facilitate data analysis. For the positively worded items, "strongly agree" and "agree" were designated as "agree," and the remaining three responses were designated as "disagree." For the negatively worded questions, "strongly disagree" and "disagree" were combined to form the "disagree" category, and the remaining three responses were grouped into "agree." For the satisfaction questions, "very satisfied" and "satisfied" were designated as "satisfied," and the remaining three categories were combined into "dissatisfied."

Figure 1

Sample of Rounding Report

University of Missouri Hospital	Tuesday, 03/30/10 11:12 am
Adult Inpatient Rounding Report	DNAR (Do Not Attempt Resuscitation) 03/29

Age: 79 Y (DOB:

MRN: **Admit:** MON, 03/29 17:23 (HD2) **Admit Dx:** **PCP:**
Room: 6W42 **Admit Wt:** 76.20 kg/ 167.64 lbs **From:** Non–Health Care Facility **Attending:**
DVT: SCD **Service:** Family Medical Care **Allergies:** atenolol, penicillin, Nubain, Novocain

Vitals	(date–time) [36hr range]	I/Os	Midnight to Current		IV/Diet/Telemetry
T: 36.0	[36.0–36.5]	In:	350.00	(31.24 ml/hr)	Dextrose 5% with 0.45% NaCl 1,000 mL 1,000 mL IV; esomeprazole 80 mg + Sodium Chloride 0.9% 100 mL + Total Volume 110 mL 100 mL IV
HR: 69	[64–86]	Out:	850.00	(75.86 ml/hr)	
BP: 152/57	[138–169/47–71]	Bal:	−500.00		
RR: 20	[18–22]	**24 Hour Prev Day**			03/30–NPO After Midnight; 03/29–Liquid Clear; Room Service; Room Service
Wt: 76.200	[76.2–76.2]	In:	0.00	(0.00 ml/hr)	
Pain: 0	[0–0]	Out:	0.00	(0.00 ml/hr)	
SpO2: 94	[94–98]	Bal:	0.00		Telemetry/Cardiac Monitoring 03/29

Diagnoses
Anemia NOS
Problems
Benign essential tremor
Coronary artery disease
Family history of cancer of colon
Hypertension
Osteoarthritis
Tobacco abuse

Medication Orders
albuterol–ipratropium 4 Puff Inhalation Every hour as nee...
albuterol–ipratropium 4 Puff Inhalation Four times daily
Cardizem CD 120 mg Oral Every 12 hours
clopidogrel 75 mg Oral Every morning
isosorbide dinitrate 20 mg Oral Three times daily

Home Medication Orders
Home medications unable to be viewed in publication

Labs (last three charted values)

WBC: 5.1 (03/30) 5.9 (03/29)
HGB: L 7.2 (03/30) 5.2 (03/29)
PLT: 246 (03/30) 247 (03/29)
Na+: 140 (03/29)
K+: 3.5 (03/29)
Cl−: 110 (03/29)
CO2: 25 (03/29)
Glu: H 116 (03/29)
BUN: 21 (03/29)
Cr: H 1.22 (03/29)
PT: H 17.0 (03/29)
PTT: 31.2 (03/29)

INR: H 1.3 (03/29)
Alk Phos: 111 (03/29)
AST: 12 (03/29)
ALT: L 9 (03/29)
T Bili: 0.4 (03/29)

Radiology and Diagnostic Rpts
Dobutamine Stress Echo Report 04/02 04/02; Endoscopy Reports 02/10

Ordered Labs
Slide Review03/30; CK and CKMB03/30; Troponin–I03/30

In Process Labs
Crossmatch IS03/29

Other Labs (not CMP or HPD over past 2 days)
03/29–INR (H1.3);PT (H17.0);PTT (31.2)

Pilot phase – confirm in chart before orders.

Notes

McNemar's exact test was used to compare responses on the pre- and post-implementation surveys.

Results

Survey Response and Rounding Report Usage

For both the pre- and post-implementation survey, we had a 57% response rate (53/93 and 62/108, respectively). However, only 18 residents and 15 attendings completed both surveys (Table 1). The respondents who completed both surveys did not differ from those who completed only the pre-implementation survey on any of the time measures. We did, however, find a statistically significant difference between respondents who completed only the post-implementation survey and respondents who completed both surveys regarding time spent pre-rounding (29 and 48 minutes, respectively, $P=.02$). Survey questions and respondents are summarized in Table 2 (survey questions in Table 2 are hereafter referred to as Q1–Q23).

Uptake and utilization of the report was quick, as evidenced by the 82% adoption rate across attendings and residents (Q19). Almost all residents (96%) who responded to the post-implementation survey acknowledged using the report for pre-rounds (Q21). Many users (27%) reported that they use the Rounding Report for "other uses" (Q23), which typically included comments like "billing," "taking notes," and "handy information when making decisions on patients throughout the day."

Time Savings

In our post-implementation survey, both residents and attendings reported a 44 minute per day time savings with use of the Rounding Report (Q18). On average, each of our five general medical services consists of four residents and one attending. This daily time savings translates into 274 hours saved per physician per year or 1,369 hours saved per service per year, or 6,844 hours saved for all five services per year. When asked about specific activities like pre-rounding, rounding, updating a patient list, and signing out (Q14–Q17), the summed time savings was similar at 46 minutes total per day (10, 5, 30, and 1 minute respectively saved per activity). We found a statistically significant difference for the decrease in time spent pre-rounding and updating a patient list ($P=.04$ and $P=.003$ respectively). Virtually all users (88%) reported that the rounding report saved them time (Q20). Participants reported increased ease adhering to the 80-hour work rule (Q4, 28% pre-implementation, 50% post-implementation) and to the 30-hour work rule (Q5, 22% and 33%, respectively), but these differences were not statistically significant. Residents also reported spending less time copying data from the EMR to a separate patient list—residents' disagreement with the statement "I spend too much time updating a separate patient list" (Q7) increased from 0% to 72% ($P<.0001$).

Improved Satisfaction

Overall, 88% of the resident and attending respondents to the post-implementation survey reported being satisfied with the Rounding Report (Q13). Residents and attendings reported improvement in their satisfaction with inpatient service rounding from 59 to 84% ($P=.008$; Q11). While not statistically significant, residents answering both surveys reported increased satisfaction with pre-rounding (Q10, 50% before implementation, 81% after implementation) and with the sign-out process (Q12, 29% and 47%, respectively). In addition, residents' confidence while cross-covering increased from 44% to 67% (Q3).

Increased Patient Safety and Face-to-face Time

The majority (76%) of post-implementation survey respondents felt that the Rounding Report improved patient safety (Q6). After implementation, more respondents disagreed with the statement "Information on sign-out sheets frequently includes some incorrect information" (22%, compared with 6% before implementation; Q8). Respondents were also more likely to disagree with the negative statement "Clinically relevant errors occur frequently with patients hospitalized on our service" (31% before implementation and 41% after implementation; Q9). After implementation, respondents were more likely to agree with the statements "I receive adequate information from my co-workers during sign-out" (Q2, 56% compared with 44% before implementation) and "I spend enough face-to-face time with the patients when on the inpatient service" (39% versus 30% before implementation; Q1).

Table 1

Characteristics of Survey Respondents

	Pre-implementation Survey n (%)	*Post-implementation Survey n (%)*
Invited (n)	93	108
Specialty		
Family medicine	34 (64)	45 (73)
Internal medicine	19 (36)	17 (27)
Training Level		
Resident	31 (58)	45 (73)
Attending	22 (42)	17 (27)
Completed Total	53	62

Table 2

Summary of Survey Questions, Participants Included in Analyses, and Responses*

			% Agree or Strongly Agree	
Questions that represent a positive outlook:	**Group**	**n**	**Before Survey**	**After Survey**
1. I spend enough face-to-face time with the patients when on the inpatient service.	All respondents	33	30.3	39.4
2. I receive adequate information from my coworkers during sign-out.	Residents only	18	44.4	55.6
3. I feel confident caring for patients when I am cross-covering.	Residents only	18	44.4	66.7
4. I can easily adhere to the 80-hour work week rule.	Residents only	18	27.8	50.0
5. I can easily adhere to the 30-hour work rule for overnight call.	Residents only	18	22.2	33.3
6. Patient safety is improved by using the rounding report (after survey only)	All respondents who use report	50	N/A	76.0
			% Disagree or Strongly Disagree	
Questions that represent a negative outlook:	**Group**	**n**	**Before Survey**	**After Survey**
7. I spend too much time updating a separate patient list.	Residents only	18	0.0	72.2
8. Information on sign-out sheets frequently includes some incorrect information.	Residents only	18	5.6	22.2
9. Clinically relevant errors occur frequently with patients hospitalized on our service.	All respondents	32	31.2	40.6
			% Satisfied or Very Satisfied	
Questions relating to satisfaction:	**Group**	**n**	**Before Survey**	**After Survey**
10. Overall, how satisfied are you with pre-rounding on your hospitalized patients?	Residents only	16	50.0	81.2
11. Overall, how satisfied are you with the inpatient rounds on your service?	All respondents	32	59.4	84.4
12. Overall, how satisfied are you with the sign-out process for your service?	Residents only	17	29.4	47.1
13. Overall, how satisfied are you with using the rounding report? (after survey only)	All respondents	50	n/a	88.0
			Mean (SD) Number of Minutes	
Questions that relate to the amount of time spent "on a typical day on your inpatient service:"	**Group**	**n**	**Before Survey**	**After Survey**
14. How many minutes on average do you spend pre-rounding?	Residents only	17	53 (21)	43 (22)
15. How many minutes on average do you spend rounding on patients?	All respondents	28	108 (59)	103(49)
16. How many minutes on average do you spend updating a patient list (eg, Word document)?	Residents only	17	41 (11)	11 (15)
17. How many minutes on average do you spend signing out to co-workers?	Residents only	17	18 (10)	17 (9)
18. On a typical day on your inpatient service, using the rounding report saves/ costs you an average of how many minutes per day? (after survey only)	All respondents	31	N/A	44 (55)
			% Who Responded Yes	
Questions on the post-implementation survey only:	**Group**	**n**	**Before Survey**	**After Survey**
19. Are you using the rounding report?	All respondents	60	N/A	81.7
20. In general, does the rounding report save you time?	All respondents who use report	52	N/A	88.5
21. Are you using the rounding report for pre-rounds?	Residents who use report	26	N/A	96.2
22. Are you using the rounding report for sign-out?	Residents who use report	26	N/A	73.1
23. Are you using the rounding report for other purposes?	Residents who use report	26	N/A	26.9

* Unless otherwise noted, only respondents who answered both surveys are included.

Discussion

We were able to demonstrate that an EMR-generated rounding report could save physician time, increase satisfaction, and improve perceived patient safety. Similar to the findings of Van Eaton, junior residents reported a time savings of 45 minutes per day.[9] However, their system did not report any time savings for attending physicians, and the time savings for senior residents was estimated at only 30 minutes. In contrast, our users reported a 45-minute time savings across all levels of training. This may be in part to the automated nature of our single system design.

Our report was fully integrated into the EMR, not a separate system, and still allows users to have remote access and allow resident notes. We believe this particular document format and the use of the EMR to generate all of the data for our Rounding Report to be unique. All previously reported systems in the literature describe a separate rounding and sign-out system from their EMR system.[11,13-15] However, data may only be updated sporadically (eg, hourly) in separate systems, which may not be ideal for morning pre-rounds when vitals and labs are needed more frequently. Some existing systems, like UWCores, still require considerable manual data entry into a separate system.[9,15]

Rounding reports have been used at some hospitals over the past decade, but there is little evaluation and even less published research in the literature on this topic. Only 1.5% of US hospitals have a comprehensive EMR system, and only an additional 7.6% have a basic EMR system.[16] Physicians' resistance is a major perceived barrier for hospitals to adopt such systems.[16] As fully functional EMRs become more commonplace, the ability to have a single system that can store and generate all of the relevant information that a physician team needs will become easier. Improved efficiency, patient safety, and quality of care with the use of such tools can hopefully reduce the barrier of physician resistance.

Limitations

Recall bias and selection bias are always a potential limitation with surveys. However, we did have a fairly high response rate (57%) for both the pre- and post-implementation components. It is possible that some residents completed the survey up to 5 months after finishing their inpatient rotation. However, most residents completed the survey within 1 or 2 months of their rotation and had additional experience using the system on other inpatient rotations. Direct observation of physicians with a time on task analysis would help to eliminate that bias in future studies. Since we did not have a cross-over study design, one might argue that respondents gained experience and became more efficient regardless of our intervention. However, attend-

ings, who would not be expected to have a significant learning curve, showed similar results to residents. We were surprised that the attendings reported a similar time savings to the residents at 45 minutes per day; this could be from the attendings not needing to look at the computer as much during rounds or from time savings gained from more efficient billing or resident note review. While response was fairly high, only 36 respondents answered both surveys, limiting the comparisons we could do. In addition, the popularity of this tool may have lent itself to a "halo effect" and increased positive physician perception of all areas.

Our study also spanned the timeframe when residents transition from intern to senior resident, which can significantly change their role and activities (less time pre-rounding as a senior resident). We did notice a statistically significant difference in pre-rounding time between the post-implementation only survey respondents and those who responded to both surveys, but we believe this is to be expected as there were 15 new interns in the post-implementation only group, who would be doing the majority of the pre-rounding on the service. In addition, a new inpatient progress note was implemented during our study period that could also have affected resident satisfaction and efficiency gains.

Future Thoughts

We continue to get more enhancement requests for the Rounding Report than our current resources can keep up with. We see a need to expand the report to other services such as the special needs and requirements of the pediatric populations, nursing staff, emergency room, surgical subspecialties, intensive-care unit, and obstetrics. The report can be utilized by staff other than physicians—nursing staff and social services have used this report when transferring patients to outside facilities such as nursing homes.

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